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(54) **ADJUSTING COOLING AIR IN GLASS TEMPERING APPARATUS**

REGULIERUNG DER LUFTKÜHLUNG IN EINER MASCHINE ZUM HÄRTEN VON GLAS

REGLAGE DE L'AIR DE REFROIDISSEMENT D'UN DISPOSITIF DE TREMPAGE DU VERRE

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Description

[0001] The invention relates to a method for adjusting the pressure of the cooling air of a glass tempering apparatus, in which method cooling air is led to a tempering area for cooling the glass sheets exiting a tempering furnace.

[0002] The invention also relates to an equipment for adjusting the pressure of the cooling air of a glass tempering apparatus, the equipment comprising at least one fan and a channel system for leading cooling air to a tempering area for cooling the glass sheets exiting a tempering furnace.

[0003] When tempering glass, the temperature of the glass is increased above the softening point of glass in the tempering process. For this purpose tempering furnaces are used, currently typically what are known as oscillating roller furnaces. After the tempering furnace the glass is led to temper cooling. Tempering thin glasses, typically with a thickness of 2.8 to 3.8 mm, requires a high tempering pressure provided by a fan, e.g. a pressure of about 20 to 25 kPa. The alternative is to use the combined effect of fan air and compressor air, whereby an about 8 to 10 kPa tempering pressure is sufficient with the tempering effect practically emanating from the compressor. Thin glasses are tempered either in a separate tempering zone through which the glasses are conveyed without stops. After the tempering zone, the glasses are led to an aftercooling unit where they are oscillated in a reciprocating manner upon rollers. The blast pressure of the tempering zone is provided e.g. by series-connected high-pressure fans. Such a separate tempering zone involves expensive equipment and structural investments. Furthermore, said tempering zone cannot be utilized in connection with glasses with a thickness of 4 mm or more, the aftercooling unit operating as their tempering unit. Tempering thin glasses may be implemented also without a separate tempering zone by blowing pressurized air at the glasses both by fans and by the compressor. This, however makes the anisotropy pattern of the glass quite uneven as the air jets are formed spotlike. Furthermore, a separate compressor is needed, and, in order to increase the capacity, the compressor should be expanded with increased capacity.

[0004] On the other hand, when tempering thick glasses, the blast pressure has to be sufficiently low. Typically this problem is solved by adjusting the speed of rotation of the fan motors. EP-A-0 282 947 discloses an alternative way to achieve low blast pressure. Said publication describes a solution with at least two fans, fan channels between the fans and the air delivery chamber, and a bypass channel connecting the fan channels. A gate valve is disposed after the bypass channel 7 between the fan channel and the air delivery chamber, the plate being in throttle position when one fan is switched on with the guide vane control closed and another fan is switched off with the guide vane control partially or entirely open. The air is led by the bypass channel 7 to the channel of the other fan, from where it exits via the open guide vane control. This way, the gate valve being in its maximum throttle position, the desired minimum pressure is achieved for the nozzles. Said solution and adjusting the speed of rotation of the fan motors require, however, a completely separate solution in tempering thin glasses.

[0005] It is the object of the present invention to provide a method and an equipment for avoiding the above mentioned drawbacks and for implementing temper cooling simply within a wide range of glass thickness.

[0006] The method of the invention is characterized in that the supply of cooling air to a portion of the tempering area is closed off whereby a tempering zone adjacent the tempering furnace is formed with a length that is reduced in relation to that of the tempering area and where the pressure of the cooling air can be raised sufficiently high for tempering thin glass sheets and in that the glass sheets are led through the tempering zone, after which the initial tempering area is restored by supplying the cooling air to the complete area again and the glass sheets are oscillated within the entire length of the tempering area, the entire tempering area serving as an aftercooling unit.

[0007] The equipment of the invention is characterized in that the equipment comprises a closing device which in its closed position leads the cooling air only to the first part of the tempering area adjacent the tempering furnace, thus creating a tempering zone shorter than the entire tempering area in which the pressure of the cooling air can be raised sufficiently high by means of at least one fan for tempering thin class sheets, means for leading the glass sheets through the tempering zone, controlling means for closing and opening the closing device which is put in the open position after the glass sheets are led through the tempering zone and means for oscillating the glass sheets within the entire tempering are, the entire tempering area serving as an aftercooling unit.

[0008] It is an essential idea of the invention that the tempering area can be reduced by a closing device, whereby a tempering zone with a pressure that can be raised sufficiently high for tempering thin glass can be formed out of the reduced tempering area. Furthermore, the closing device can be opened for the aftercooling of thin glasses or the tempering of thicker glasses, for example. It is the idea of still another preferred embodiment that the tempering area is reduced to a tempering zone of half the size of the tempering area. It is the idea of another preferred embodiment that the equipment comprises at least two fans which can be connected both in series and in parallel by means of channel systems and a gate valve.

[0009] It is an advantage of the invention that the tempering result achieved is very even. Furthermore, space is saved as no separate tempering zone is needed even for thin glasses. This also lowers acquisition costs. A

separate compressor is not needed either, but instead two moderately sized fans are sufficient to provide tempering air to the entire thickness area of the glass.

[0010] The invention will be described in more detail in the attached drawings in which

Figure 1 schematically shows an equipment according to the invention adapted for thin glasses.
Figure 2 shows the equipment of Figure 1 adapted for medium-thin glasses,
Figure 3 shows the equipment of Figure 1 adapted for medium-thick glasses, and
Figure 4 shows the equipment of Figure 1 adapted for thick glasses.

[0011] Figure 1 schematically shows a blast pressure unit according to the invention. The blast pressure unit comprises a first fan 1 and a second fan 2, connected by a channel system 3 for blast air at the tempering area 4. A bypass channel 3a is further connected to the channel system 3, but is closed in the case of Figure 1 by a first gate valve 5 of the bypass channel 3a and by a second gate valve 6 of the bypass channel 3a such that no air flows in the bypass channel 3a. Instead, the air originating from the first fan 1 is led to the second fan 2, from which the air is led further, i.e. the first fan 1 and the second fan 2 are coupled in series. A suction port 7 in the second fan 2 is closed by a gate valve 8 in the suction port 7. The travel of air to tempering nozzles disposed above and below the glass is controlled by a regulating device 9 which uses throttle control to adjust the desired tempering pressure on the upper and lower sides. A closing device 10 is in its closed position, the tempering blast being led only to the end of the tempering area 4 facing the tempering furnace 11, i.e. the first part 4a of the tempering area 4. The latter part 4b of the tempering area 4 becomes thus depressurized and a maximum tempering pressure of about 20 to 25 kPa, for example, is reached in the first part 4a. In Figure 1, the airflow is illustrated by arrows.

[0012] After the tempering furnace, thin glasses, in this context glasses with a thickness of 2.8 to 3.8 mm, are led through the first part 4a of the tempering area 4 operating as the tempering zone, the blast pressure unit being adapted in accordance with Figure 1. The area of the tempering zone is preferably about one half, i.e. 35 to 65%, of the area of the tempering area 4. When the glasses have passed across the pressurized first part 4a, the closing device 10 is opened, whereby the entire tempering area 4 is subjected to blowing. In addition, it is possible, particularly when full-length loads are concerned, to transport the glasses to an auxiliary conveyer disposed between a chiller and a loading table, from where they return to the blowing zone. Naturally this blowing is significantly less pressurized than the blowing directed at the first part 4a in the case shown in Figure 1. The glass load is oscillated over the entire length of the tempering area 4, and it is possible to aftercool thin glasses to processing temperature, although then they are not subjected to so high a pressure as at the tempering stage.

[0013] Figure 2 shows the equipment of Figure 1 adapted for medium-thin glasses. The numbering of Figure 2 corresponds to that of Figure 1. In this context, medium-thin glasses refer to glasses with a thickness of 3.8 to 4.8 mm. The first gate valve 5 of the bypass channel 3a has been turned such that the airflow of the first fan 1 is led to the bypass channel 3a. Similarly, the gate valve 8 of the suction port 7 is opened such that air is led from the suction port 7 to the second fan 2. Further, the second gate valve 6 of the bypass channel 3a is adapted such that both the airflow of the second fan 2 and the airflow of the first fan 1 via the bypass channel 3a can be led to the tempering area 4. The second gate valve 6 of the bypass channel 3a is in a centre position in equilibrium, whereby an equal amount of air at the same pressure can be taken from both fans. The gate valve 6 also operates as a pressure balancer for the fans by adjusting the size of the inlet such that, when needed, it throttles one channel in case balance is lost. A tempering blast has been led to the entire tempering area 4 from the starting moment, i.e. the closing device 10 is open all the time. Typically, the need for tempering pressure is about 7 to 10 kPa. Thus the first fan 1 and the second fan 2 operate connected in parallel, and the air blown by them is fed to the entire tempering area 4.

[0014] Figure 3 shows the blast pressure unit of the invention adapted for medium-thick glasses. The numbering of Figure 3 corresponds to that of Figures 1 and 2. In this context, medium-thick glasses refer to glasses with a thickness of 4.8 to 10 mm. The second fan 2 is switched off and the blast air of the first fan 1 is adapted to pass along the bypass channel 3a by means of the first gate valve 5 and the second gate valve 6 of the bypass channel 3a to the tempering area 4. The closing device 10 is open, whereby the blast is directed at the entire tempering area 4. The need for tempering pressure is in the range 3 to 5 kPa. The pressure level is adjusted by the guide vane control of the fan. The second fan 2 may also be used for blowing, whereby the first fan 1 is switched off and the bypass channel 3a is closed by the gate valves 5 and 6 of the bypass channel 3a. This way the fans can be used equally, whereby the bearings or other mechanics of either fan do not wear essentially more rapidly that that of the other, and the blast pressure unit remains in working order longer than if only one of the fans were used.

[0015] Figure 4 shows the blast pressure unit of the invention adapted for tempering thick glasses. The numbering of Figure 4 corresponds to that of Figures 1 to 3. In this context, thick glasses refer to glasses with a thickness of 10 to 19 mm. Particularly when very thick glasses, i.e. thickness 15 to 19 mm, are concerned, the tempering pressure must be very low, e.g. 50 to 100 Pa. In the case shown in Figure 4, the second fan 2 is switched off and only the first fan 1 is working with its guide vane

control closed. The blast air of the first fan 1 is led to the bypass channel 3a by the first gate valve 5 of the bypass channel 3a. The second throttle 6 of the bypass channel 3a is in an intermediate position, whereby the air coming from the bypass channel 3a is allowed to flow through the second fan 2 and further out of the suction port 7. The tempering pressure can be adjusted by means of the positions of the gate valves 6 and 8, and, when needed, also by means of the guide vane control of the first fan 1. It is also possible for a part of the air produced by the first fan 1 to be led out of the system directly via the gate valves 5 and 8, whereby the tempering pressure is adjusted by means of the positions of these two gate valves.

[0016] In the blast pressure unit according to the invention, one of the fans, for example, may be a so-called two-speed fan, whereby a low tempering pressure is achieved by using the lower speed of rotation of the blast engine, and adjust the pressure level by means of the guide vane control of said fan. Furthermore, the speed of rotation of the fan may be adjusted e.g. by means of inverter drive.

[0017] The drawing and the related description are only intended to illustrate the idea of the invention. As to its details, the invention may vary within the scope of the claims. The glass thickness values presented in the description serve only as examples, and, according to the need, each presented embodiment of the equipment may naturally be used with another glass thickness than that presented, depending on the fan dimensioning, for example.

Claims

1. A method of adjusting the pressure of the cooling air of a glass tempering apparatus, in which method cooling air is led to a tempering area (4) for cooling the glass sheets exiting a tempering furnace (11), **characterized in that** the supply of cooling air to a portion of the tempering area is closed off whereby a tempering zone adjacent the tempering furnace is formed with a length that is reduced in relation to that of the tempering area and where the pressure of the cooling air can be raised sufficiently high for tempering thin glass sheets and **in that** the glass sheets are led through the tempering zone, after which the initial tempering area is restored by supplying the cooling air to the complete area again and the glass sheets are oscillated within the entire length of the tempering area (4), the entire tempering area (4) serving as an aftercooling unit

2. A method as claimed in claim 1, **characterized in that** the area of the tempering zone formed out of the tempering area (4) is 35 to 65% of the area of the tempering area (4).

3. A method as claimed in claim 1 or 2, **characterized in that** cooling air is provided by at least two fans (1, 2), connected either in series or in parallel, depending on the thickness of the glass.

4. An equipment for adjusting the pressure of the cooling air of a glass tempering apparatus, the equipment comprising at least one fan (1, 2) and a channel system (3) for leading cooling air to a tempering area (4) for cooling the glass sheets exiting a tempering furnace (11), **characterized in that** the equipment comprises a closing device (10) which in its closed position leads the cooling air only to the first part of the tempering area adjacent the tempering fumace (11), thus creating a tempering zone shorter than the entire tempering area in which the pressure of the cooling air can be raised sufficiently high by means of at least one fan for tempering thin glass sheets, means for leading the glass sheets through the tempering zone, controlling means for closing and opening the closing device (10) which is put in the open position after the glass sheets are led through the tempering zone and means for oscillating the glass sheets within the entire tempering area (4), the entire tempering area (4) serving as an aftercooling unit.

5. An equipment as claimed in claim 4, **characterized in that** the closing device (10) is adapted such that the area of the tempering zone is 35 to 65% of the area of the tempering area (4).

6. An equipment as claimed in claim 4 or 5, **characterized in that** the equipment comprises at least two fans (1, 2), a bypass channel (3a), and gate valves (5, 6, 8) such that the fans (1, 2) can be connected both in series and in parallel.

Patentansprüche

1. Verfahren zum Regulieren des Druckes der Kühlluft in einer Vorrichtung zum Härten von Glas, bei dem Kühlluft in einen Härtungsbereich (4) geleitet wird, um die aus einem Härteofen (11) austretenden Glasplatten zu kühlen, **dadurch gekennzeichnet, daß** die Zufuhr von Kühlluft zu einem Teil des Härtungsbereichs abgesperrt wird, wodurch eine an den Härteofen angrenzende Härtezone ausgebildet wird, die eine in bezug auf die Länge des Härtungsbereiches verkürzte Länge hat und in der der Druck der Kühiluft ausreichend erhöht werden kann, um dünne Glasplatten zu härten, und daß die Glasplatten durch die Härtezone geführt werden, woraufhin der ursprüngliche Härtungsbereich wiederhergestellt wird, indem die Kühlluft in den gesamten Bereich eingeführt und die Glasplatten innerhalb der gesamten Länge des Härtungsbereiches (4) hin-

und herbewegt werden, wobei der gesamte Härtungsbereich (4) als Nachkühlungseinheit dient.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** der Raum der aus dem Härtungsbereich (4) heraus ausgebildeten Härtezone 35 bis 65% des Raums des Härtungsbereichs (4) ausmacht.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** die Kühlluft aus mindestens zwei Gebläsen (1, 2) abgegeben wird, die je nach Glasstärke entweder in Reihe oder parallel geschaltet sind.

4. Einrichtung zum Regulieren des Druckes der Kühlluft einer Vorrichtung zum Härten von Glas, wobei die Einrichtung mindestens ein Gebläse (1, 2) und ein Kanalsystem (3) zum Einleiten von Kühiluft in einen Härtungsbereich (4) zum Abkühlen der aus einem Härteofen (11) austretenden Glasplatten hat, **dadurch gekennzeichnet, daß** die Einrichtung eine Schließvorrichtung (10) enthält, die in ihrer geschlossenen Stellung die Kühlluft nur in den ersten Teil des an den Härteofen (11) angrenzenden Härtungsbereichs leitet und so eine Härtezone ausbildet. die kürzer als der gesamte Härtungsbereich ist und in der der Druck der Kühlluft durch mindestens ein Gebläse ausreichend erhöht werden kann, um dünne Glasplatten zu härten, sowie Mittel zum Führen der Glasplatten durch die Härtezone, Steuermittel zum Schließen und öffnen der Schließvorrichtung (10), die in die offene Stellung gebracht wird, nachdem die Glasplatten durch die Härtezone geführt wurden, und Mittel zum Hin- und Herbewegen der Glasplatten in dem gesamten Härtungsbereich (4), wobei der gesamte Härtungsbereich (4) als Nachkühleinheit dient.

5. Einrichtung nach Anspruch 4, **dadurch gekennzeichnet, daß** die Schließvorrichtung (10) so ausgebildet ist, daß der Raum der Härtezone 35 bis 65% des Raums des Härtungsbereichs (4) ausmacht.

6. Einrichtung nach Anspruch 4 oder 5, **dadurch gekennzeichnet, daß** die Einrichtung mindestens zwei Gebläse (1, 2), einen Umleitungskanal (3a) und Schieber (5, 6, 8) umfaßt, so daß die Gebläse (1, 2) sowohl in Reihe als auch parallel geschaltet werden können.

Revendications

1. Procédé d'ajustement de la pression de l'air de refroidissement d'un dispositif de trempe de verre, procédé dans lequel l'air de refroidissement est conduit vers une aire de trempe (4) pour refroidir les feuilles de verre sortant d'un four à recuire (11),

caractérisé en ce que l'alimentation d'air de refroidissement vers une partie de l'aire de trempe est fermée, de sorte qu'une zone de trempe adjacente au four à recuire est formée en ayant une longueur qui est réduite par rapport à celle de l'aire de trempe, et où la pression de l'air de refroidissement peut être élevée suffisamment haut pour tremper des feuilles de verre minces, et **en ce que** les feuilles de verre sont conduite à travers la zone de trempe, après quoi l'aire de trempe initiale est réinitialisée en alimentant l'air de refroidissement à nouveau vers l'aire complète, et les feuilles de verre sont mises en oscillation dans toute la longueur de l'aire de trempe (4), toute l'aire de trempe (4) servant d'unité de refroidissement postérieur.

2. Procédé selon la revendication 1,

caractérisé en ce que l'aire de la zone de trempe formée à l'extérieur de l'aire de trempe (4) est de 35 % à 65 % de l'aire de l'aire de trempe (4)

3. Procédé selon la revendication 1 ou 2,

caractérisé en ce que l'air de refroidissement est fourni par au moins deux ventilateurs (1, 2), connectés en série ou en parallèle, selon l'épaisseur du verre.

4. Equipement pour ajuster la pression de l'air de refroidissement d'un dispositif de trempe de verre, l'équipement comportant au moins un ventilateur (1, 2) et un système de canaux (3) pour mener l'air de refroidissement vers une aire de trempe (4) afin de refroidir les feuilles de verre sortant d'un four à recuire (11),

caractérisé en ce que l'équipement comporte un dispositif de fermeture (10) qui, dans sa position fermée, mène l'air de refroidissement uniquement vers la première partie de l'aire de trempe adjacente au four à recuire (11), en créant ainsi une zone de trempe plus courte que toute l'aire de trempe, dans laquelle la pression de l'air de refroidissement peut être élevée suffisamment haut par l'intermédiaire d'au moins un ventilateur pour tremper des feuilles de verre minces, des moyens pour mener les feuilles de verre à travers la zone de trempe, des moyens de commande pour fermer et ouvrir le dispositif de fermeture (10) qui est mis dans la position ouverte après que les feuilles de verre aient été menées à travers la zone de trempe, et des moyens pour faire osciller les feuilles de verre dans toute l'aire de trempe (4), toute l'aire de trempe servant d'unité de refroidissement postérieur.

5. Equipement selon la revendication 4,

caractérisé en ce que le dispositif de fermeture (10) est adapté de telle sorte que l'aire de la

zone de trempe est de 35 % à 65 % de l'aire de l'aire de trempe (4).

6. Equipement selon la revendication 4 ou 5, **caractérisé en ce que** l'équipement comporte au moins deux ventilateurs (1, 2), un canal de dérivation (3a) et des vannes à tiroir (5, 6, 8), de telle sorte que les ventilateurs (1, 2) peuvent être connectés en série et en parallèle.

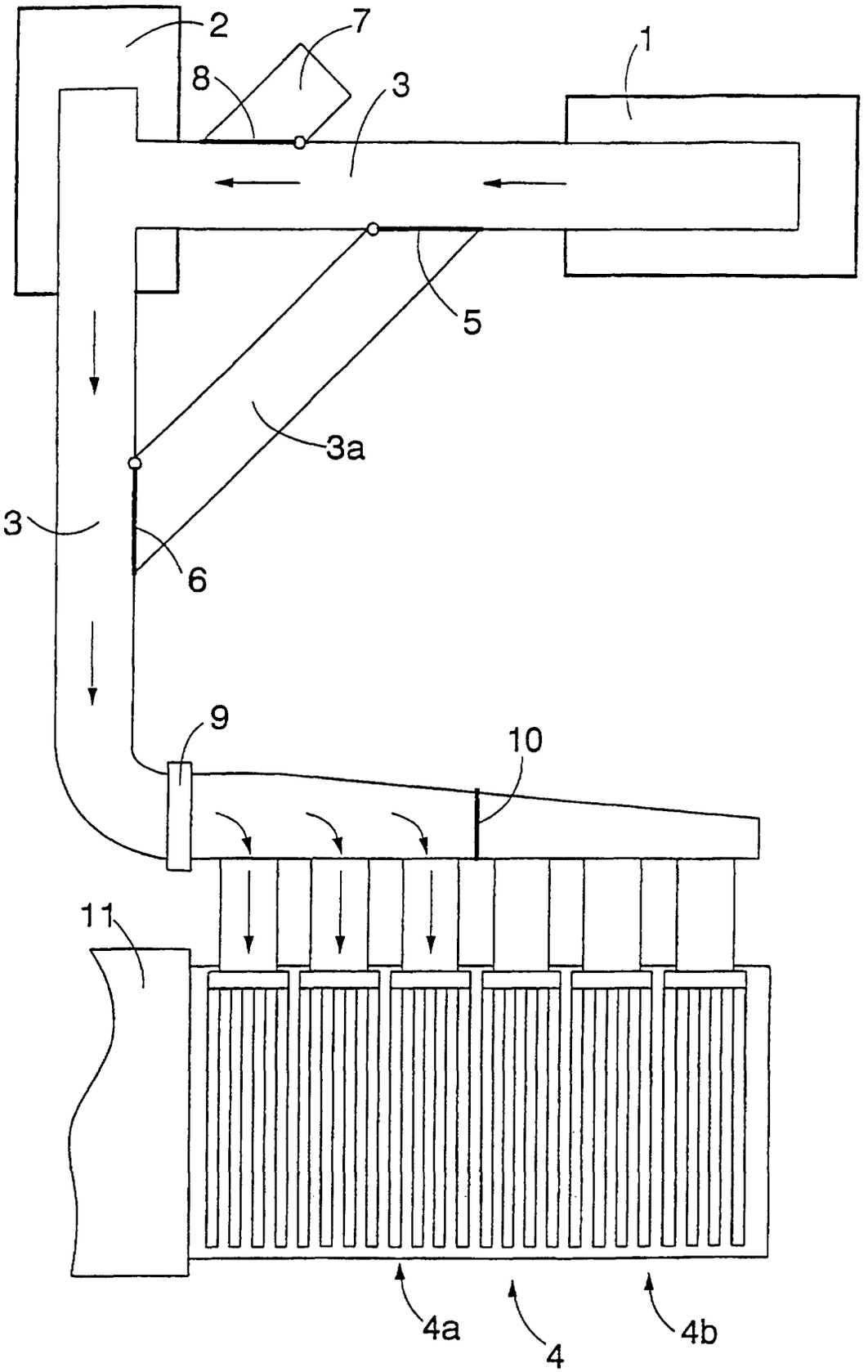

FIG. 1

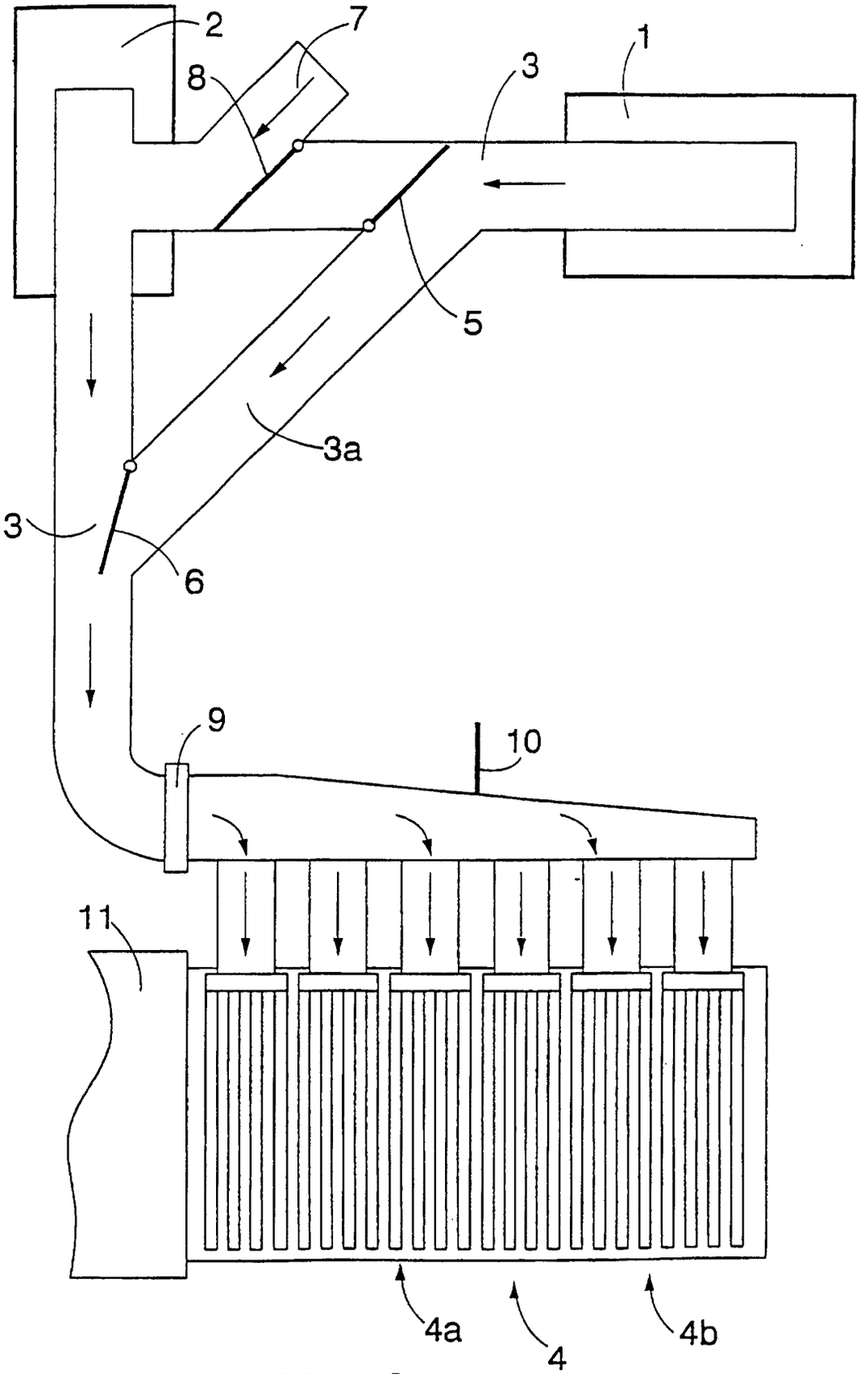

FIG. 2

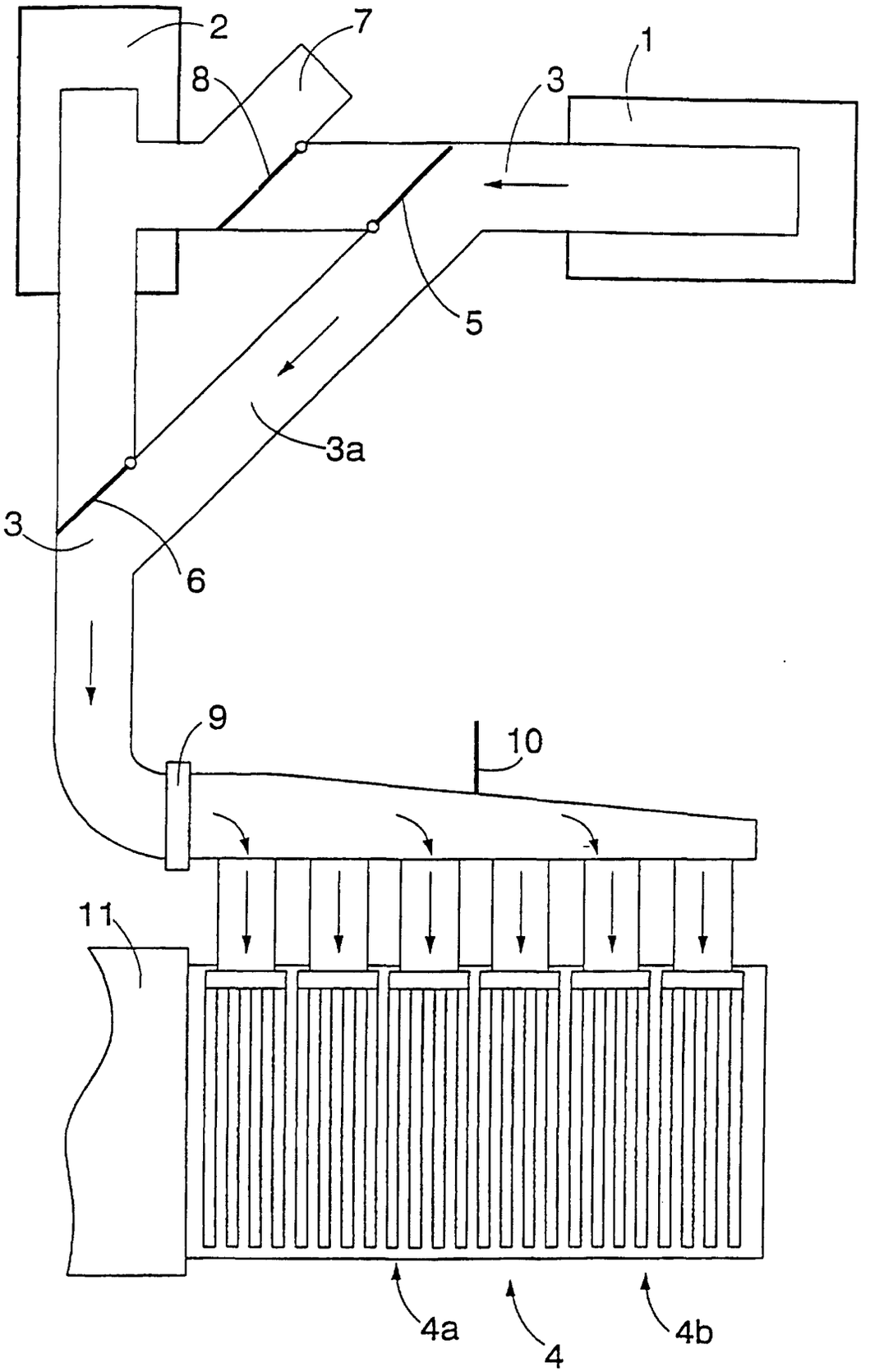

FIG. 3

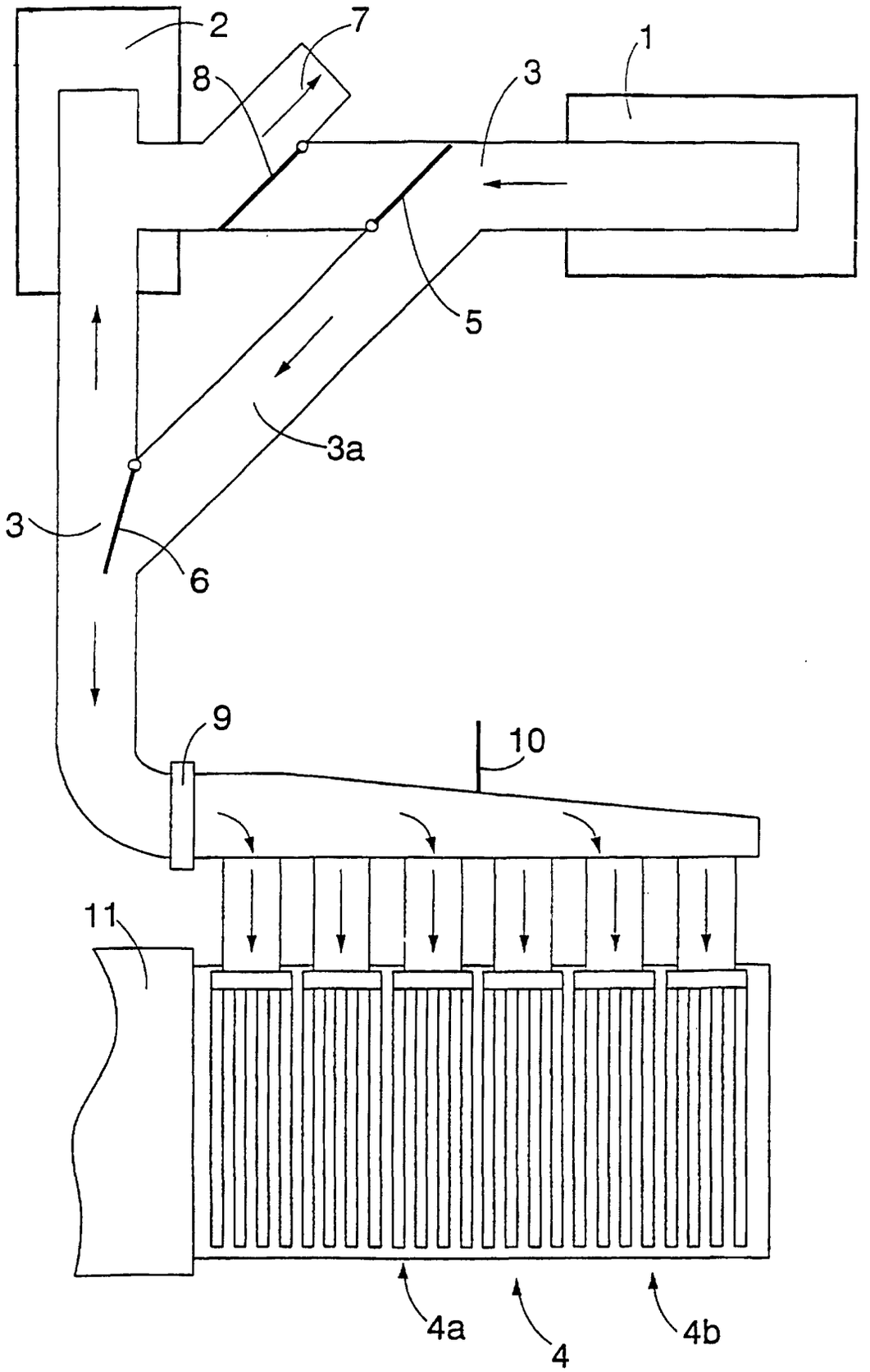

FIG. 4